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28. Argument Structure Constructions

1. Introduction

Traditional Generativist (e.g., Chomsky 1957) theory approaches the notion of argument structure by identifying two components that are involved in specifying the meaning and form of an utterance. The first is a set of culturally determined strings (lexical items). The second is a set of universal and innate "linking rules" that map aspects of sentence meaning onto a structural representation of its form (syntax). Central to these approaches is the notion that aspects of sentence meaning, specifically relational meaning ("who does what to whom") as well as sentence form are assumed to be projections of the semantic and syntactic properties of the main verb (we refer to this as the projectionist account of argument structure). General linking rules plus a number of structural principles connect an underlying representation of the utterance to the surface ordering of words. Most traditional generativist theories also assume multi-stratal syntactic levels of representation intervening between meaning and surface structure. In generativist theory, then, the learning issue is simplified since the language learner only has to learn the meaning of lexical items (in particular of verbs), and then select the proper underlying form and linking rules that correspond to the spoken language.

More recently, however, a new approach to argument structure has appeared. This approach, called the constructional approach, eliminates the need for many of the traditional assumptions mentioned above. A number of variations of the constructional approach to argument structure exist (e.g., Birner and Ward 1998; Croft 2001; Fillmore et al. 1988; Lakoff 1987; Langacker 1987; Michaelis and Lambrecht 1996, among others;

cf. Goldberg 2013), but these approaches share a set of core assumptions that are sufficient to distinguish them sharply from traditional generative approaches, even when not every single assumption is adopted (Goldberg 2013). Following Goldberg (2013), key tenets of the constructional approach are that 1) knowledge of language consists of learned form-meaning pairings; 2) representations are surface-oriented and non-derivational; 3) constructions exist at different levels of generalization, from the more abstract to the more concrete and lexical.

The specific approach that has been best studied empirically is represented by Goldberg's (1995, 2006) work (though we stress that much of the work is applicable to other constructional approaches). Within a constructional approach to grammar, constructions may be morphemes, words, idioms, phrases or abstract linguistic patterns. Argument structure constructions are learned form-function pairings that are posited to exist independently of the specific verbs in the sentence (see also Diessel this volume). They are networks of features specifying mappings between syntactic form and semantic-pragmatic function. The patterns are typically specified in terms of semantic and or "functional" levels of processing (as in (1) below), though they may also be specified in terms of word order (as in the NP construction). In addition, constructions may be fully abstract as in the caused-motion construction in (1) or they may be partially lexically filled as in the What's X doing Y construction (Kay and Fillmore 1999) (2).

Example	**Construction Name: Pattern**
(1) Tom put the spoon into the drawer.	Caused-Motion Construction: <NP_{agent}> <$verb_{motion}$[1]> <$NP_{patient}$> <PP_{path}>
(2) What's that fly doing in my soup?	What's X doing Y: What's X doing Y?

Constructions may be combined to form other constructions so long as their specifications do not conflict. The form or meaning of the containing construction, however, is not predictable by the sum of its parts, but is itself unique. Thus, although the caused-motion construction contains an NP and PP construction, its form and meaning are not predictable by the process of stringing NPs and PPs together with a verb.

If argument structure constructions (henceforth *constructions*) themselves are associated directly with relational meaning independent of the meaning of the verb, it should be possible to examine empirically the contribution of the construction to sentence meaning in various sentence comprehension tasks. Likewise, if constructions mediate the mapping between sentence meaning and form, constructions should also be detectable in sentence production tasks. In this chapter we first review evidence from comprehension and production studies that speakers access constructions in language use. Since constructions are *learned* form-meaning pairings, we then move on to examine the evidence that constructions are in fact learned and learnable.

2. Constructions are associated with meaning independent of the verb

The first study to examine the contribution of constructions to sentence meaning was Bencini and Goldberg (2000). The study compared the semantic contribution of the

[1] The motion may be real or implied.

construction with that of the verb in a categorization task where native speakers of English were asked to sort sentences based on meaning and to provide explanations for their sortings. The stimuli were obtained by crossing four verbs (two semantically light verbs: *get*, *take*, and two semantically rich verbs: *throw*, *slice*) with four different constructions (Transitive: Verb Object, e.g., *Michelle got the book*; Ditransitive: V Object1 Object2, e.g., *Chris threw Linda the pencil*; Resultative: Verb Object Result, e.g., *Nancy sliced the tire open*; Caused Motion: Verb Object Location, e.g., *Kim took the rose into the house*). Participants were instructed to sort the sixteen sentences by "overall sentence meaning" into groups of four. They were told that the purpose of the study was to understand how people sort sentences according to meaning and that there was no right or wrong answer. Non-linguistic categorization research has shown that there is a robust domain-general tendency towards "one-dimensional sorting" even with stimuli and categories that are by design created to induce multi-dimensional sorting (e.g., Medin et al. 1987). In Bencini and Goldberg's stimuli the one-dimensional sorting bias should be driven by the fact that the sentences shared a common verb. In spite of this bias, results showed that speakers categorized sentences based on overall meaning by taking into account the overall argument structure of sentences in addition to verbs. Participants' explanations for their sorting decisions, as judged by independent judges, showed that they were paying attention to sentence meaning rather than verb tokens. In some cases the explanations corresponded remarkably to the kinds of abstract relational meanings posited for constructions. For example, for a ditransitive sort, one protocol read: "In this pile there were two people, and one person was doing something for the other person" (cf. Ditransitive Meaning: X causes Y to receive Z). For a transitive sort, another protocol read: "In this pile a person is just doing something" (cf. Transitive Meaning: X acts on Y). Bencini and Goldberg took these results to indicate a contribution of sentence structure to sentence meaning, independent of the contribution made by the meaning of the verb. They hypothesized that participants overcame the one-dimensional sorting bias because constructions predict overall sentence meaning better than verbs.

Another series of studies that examined the semantics associated with sentence patterns was conducted by Kako (2006). Participants saw sentences composed of novel words appearing in various constructions, and were asked how likely each was to involve the semantic properties associated with the construction. For example, participants saw the sentence *The rom gorped the blick to the dax* and were asked "How likely is it that gorping involves someone or something changing location?". Results were consistent with the hypothesis that syntactic frames carry meaning independently of the meaning of verbs: likely properties for each construction received significantly higher ratings than did unlikely properties.

Additional comprehension studies that show the importance of constructions in determining aspects of sentence interpretation are the studies by Kaschak and Glenberg (2000) and Goldwater and Markman (2009). Both studies use novel verbs derived from nouns. In Kaschak and Glenberg's study, participants were given short passages that were designed to set up a transfer scenario. They were then asked to paraphrase sentences containing the novel verbs (e.g., *crutch*) and to answer questions related to the semantics of the event. Kaschack and Glenberg found that different constructions influenced speaker's interpretations of the novel verbs. If the verb occurred in the ditransitive construction (e.g., *She crutched him the apple*) they were more likely to say that sentence meant that she used the crutch to transfer him the apple. If the verb appeared in the transitive

construction (e.g., *She crutched him*) they interpreted the sentence to mean that she hit him over the head with a crutch.

Goldwater and Markman (2009) used denominal verbs that required a change of state (e.g., the noun *sauce* used as a denominal verb *to sauce* suggesting a process of turning something into a sauce), and presented them either in a passive construction (*The ripe tomatoes were sauced expertly to compliment the pasta at the gala dinner*) or a middle construction (*The ripe tomatoes had sauced expertly to compliment the pasta at the gala dinner*). Speakers should have more difficulty making sense of sentences using the verb *sauce* in the middle construction than sentences in the passive because the event structure associated with the middle construction does not entail agency, while the event structure of the passive *does* entail agency. Indeed, participants judged middle constructions with novel denominal verbs more nonsensical than passive constructions containing the same novel verbs. Critically, agency could not be contributed by the verb because these verbs were novel.

The comprehension studies reviewed so far show that constructions play a role in speaker's interpretations of sentences. The studies, however, leave open the possibility of a strategic or meta-linguistic component to participants' responses. Johnson and Goldberg (2012) addressed this concern with an online study to determine whether abstract semantics is automatically associated with syntactic frames and whether this is also true of constructions instantiated with "Jabberwocky" sentences constructed entirely with nonsense open-class words. The paradigm was a lexical decision task requiring that participants rapidly decide whether a word presented on the computer screen is a real word or not. Before each lexical decision trial, participants read a Jabberwocky sentence instantiating one of four constructions (Ditransitive: *He daxed her the norp*; Resultative: *She jorped it miggy*; Caused-motion: *He lorped it on the molp*; Removal: *She vakoed it from her*). There were two semantic congruency conditions between the verb and the preceding construction: congruent and incongruent. For example, when *gave* was preceded by the ditransitive construction (e.g., *He jorped him the brap*), it is "congruent;" when *gave* is preceded by the removal construction it is incongruent. Verbs were high frequency associates of the construction or low frequency associates. High frequency associates are verbs that most frequently occur in the construction as determined by corpus studies. For example, *give* is the most frequent verb that occurs in the ditransitive. Low frequency associates are verbs that appear in the construction, but less frequently. For example, *hand* occurs in the ditransitive (e.g., *She handed him something*), but less frequently than *give* does. Results showed that when the construction and the verb were congruent, constructions elicited (*primed*) faster reaction times (RTs) compared to when they were incongruent. Moreover, constructions primed both high associate verbs, that is both verbs with which they regularly occur and verbs with which they occur less frequently. The results suggest that 1) constructions prime verb semantics during sentence comprehension, and 2) that syntactic patterns are associated with semantics even when they contain no open class lexical items.

3. Constructions mediate the mapping from "thought" to "talk" in language production

Evidence for verb-independent constructions as processing units at work in production comes from a particularly powerful experimental technique: structural priming. Structur-

al priming refers to the tendency of speakers to produce previously experienced sentence patterns in their subsequent utterances. The priming logic allows us to draw inferences about the dimensions to which the cognitive architecture is sensitive. If processing of a prime stimulus influences the processing of a subsequent stimulus (the target), we can infer that the cognitive system is sensitive to the overlapping dimensions between the prime and the target. Priming has been used to investigate linguistic representations both in adults (Branigan 1995 et al.; Bencini 2002, 2013; Goldberg 2006) and children (e.g., Bencini and Valian 2008). In the classic implementation by Bock (1986), constructional priming was demonstrated with active vs. passive and double object vs. prepositional dative constructions. Speakers were more likely to describe two-participant transitive events (e.g., a picture of dog chasing a man) with a passive if they previously heard and repeated an unrelated passive sentence with different nouns and verbs (e.g., *The 747 was alerted by the airport control tower*). Whereas these results demonstrate the existence of verb-independent constructional priming in language production, what remains unclear is the nature of the semantic information supporting the priming. There are differences among authors with respect to whether they recognize semantic roles loosely corresponding to traditional thematic/event roles (or abstract relational meaning in constructional terms) such as AGENT, THEME, LOCATION, or whether the generalizations refer to more fine-grained semantic properties such as animacy and concreteness. Evidence against a thematic-role account is that structural priming appears not to depend on the identity of thematic roles in prime and target sentences. Bock and Loebell (1990, Experiment 1) found that prepositional locatives (e.g., *The wealthy widow drove the Mercedes to the church*) primed prepositional dative descriptions to the same degree as prepositional dative primes (e.g., *The wealthy widow gave the Mercedes to the church*). The prepositional locative and the prepositional dative have similar surface structural configurations (NP [V NP [P NP] PP] VP), but they differ in the event roles associated with the prepositional argument. In the prepositional locative, the prepositional phrase encodes the location of the action, while in the dative it encodes the recipient. A second experiment found stronger evidence against a purely thematic-role account of structural repetition (Bock and Loebell 1990, Experiment 2). Locative sentences like *The 747 was landing by the control tower* primed passive descriptions as much as did passives like *The 747 was alerted by the control tower.* The locatives and passives had similar surface structures (NP [AUX V [P NP] PP] VP), but the locatives had agents as subjects, while the passives had patients as subjects. Thematic role overlap per se did not increase structural priming: locatives and passives were equally effective primes for passive descriptions. The authors took these results to suggest that structural priming does not depend on thematic overlap between prime and target sentences. Instead of thematic roles, Bock et al. (1992) proposed that basic semantic features guide for language production. Using once again a priming paradigm, they varied the animacy of the subjects of active and passive sentences, and found that an animate subject in the priming sentence increased the tendency to place animate entities as subjects in the target descriptions. Animacy priming was independent of structural priming, i.e., independent of the tendency to reuse the active or passive structure of priming sentences.

One problem in determining whether thematic roles play a role in structural priming is that in English, thematic role variations are typically accompanied by differences in sentence structure (e.g., active, passive) and/or animacy (e.g., ditransitive, prepositional dative). Chang et al. (2003), however, tested thematic-role priming without the confound-

ing influences of animacy or structural changes, using locative constructions (the so called spray-load alternation) in which crucially 1) the order of constituents varies within the same syntactic structures and 2) both arguments are typically inanimate. In the locative alternation the order of the theme (the object that moves) and the location (the place that is moved to) vary within the same surface structure, traditionally NP [V NP [P NP] PP] VP. For example, in *The man sprayed wax on the car*, *wax* is the theme and *car* is its location. The alternative order puts the location before the theme, as in *The man sprayed the car with wax*. Priming of the structural configuration should not differ, but if the order of thematic roles matters, theme-location orders should prime other theme-location orders more than location-theme orders: i.e., *The man sprayed wax on the car* should prime *The workers scuffed dirt across the kitchen floor* more than *The workers scuffed the kitchen floor with dirt*. If thematic roles are not at work in production, no differences are expected between conditions with respect to priming. Consistent with a thematic role account of priming, results showed increased use of the location-theme orders after location-theme orders in the prime, and increased use of theme-location orders after theme-location orders in the prime.

The remaining inconsistent result that supports the notion that priming in production does not depend on thematic role overlap is Bock and Loebell (1990, Experiment 2) showing that Locative sentences like *The 747 was landing by the control tower* prime passives as much as passives like *The 747 was alerted by the control tower.*

We believe that part of the debate arises from the difference between defining constructions as static knowledge representations versus dealing with the processes of language production. The process of language production by definition is meaning driven, in that it starts out with a conceptual representation in the speaker's mind (the *message*) and ends with a grammatically encoded utterance. Therefore finding that at some point during the process of producing a sentence the processor is sensitive to form and less to meaning is not evidence against constructions. Moreover, two important features of the priming experiments using Bock's original paradigm (including Bock and Loebell 1990) are the nature of the priming task, and the nature of the stimuli. Unlike comprehension priming (which measures latencies), production priming examines how people describe pictures in front of them. In Bock and Loebell's Experiment 2, the fact that the surface similarity between locative sentences and passives equally primed participants to describe target pictures using a passive sentence is not surprising on a constructional account. First, construction grammar recognizes that sentences have both form and meaning, and that these are distinct types of information and can be independently accessed by the cognitive system. Second, in the classic production priming paradigm, the semantic support for using a passive is always present in the visual stimuli: target pictures for active/passive priming are events that lend themselves to passive descriptions even without priming. They are pictures of events in which the patient/theme is animate and or salient relative to the agent, e.g., "a bee stinging a man", "a truck hitting a nurse", "lightning striking a church".

The importance of the production priming studies with respect to constructions is that it points to representations that are in all respects "like" constructions in terms of their level of abstraction and in the non-derivational nature of the mapping (Bock et al. 1992). We therefore take the existence of verb-independent priming as strong converging evidence from the psycholinguistics of production for the cognitive reality of constructions.

4. Learning argument structure constructions

An important question and source of debate in acquisition research is whether and when children's early multi-word utterances reflect generalizations over verbs. Until recently, comprehension and production data in child language pointed to a "paradox" in which children appeared to rely on more abstract representations in comprehension than production (see Tomasello 2000, for a review).

Constructions, while being abstract in the sense that they contain open slots and generalizations over classes of words (e.g., verb, noun-phrase) and meanings (e.g., X causes Y to move to Z), are not so abstract that they cannot be learned on the basis of surface patterns in much the same way that other patterns perceived in the environment are learned − that is, through the use of general cognitive abilities. Early research on constructional learning was designed to show that constructions are learned on the basis of input rather than being innate. Like projectionist accounts, this research focused on the central role of the verb, and suggested that constructions are learned on a verb-by-verb basis. That is, while children are able to demonstrate the use of some verbs in a given construction, they are unable to use other verbs in the same construction (cf. Roberts 1983). So a given child might be able to act out *Big Bird tickled Cookie Monster* but be unable to act out *Big Bird ~~hugged~~ Cookie Monster*. Tomasello's (1992) verb island hypothesis makes a similar claim: children initially construct separate verb-specific schemas representing the verb's morphological and syntactic properties (e.g., <tickler> *tickle* <ticklee>). It is only after much exposure to similar patterns with other verbs (<hugger> *hug* <huggee>, and so forth) that the child forms an abstract schema, or construction: <agent> <verb> <patient>.

Subsequent research sought to corroborate this general pattern through experimental, rather than corpus-based results, and to develop a timeline for the shift from item-based constructions to abstract schemas. Akhtar and Tomasello (1997) conducted the first such study in which the authors crucially used novel verbs to eliminate the possibility that children were relying on previously learned verb-specific patterns during testing. The authors tested 2- and 3-year-olds' comprehension (via act-out tasks) and production of reversible transitive sentences. They found that as demonstrated by previous work (e.g., Olguin and Tomasello 1993), children could produce and comprehend the novel verbs with the same patients and agents that children heard during training. However, younger children generally did not produce the verbs in constructions with patients and agents different from the ones they heard the verbs used with during training. It was not until the age of about 3 (2;9−3;8) that children were able to comprehend reversible sentences using the novel verbs and agent/patient combinations different from the ones encountered during training (cf. also Abbot-Smith et al. 2001).

These studies mark an important departure from projectionist accounts. Because the projectionist account posits innate linking rules that dictate the form and meaning of an utterance by mapping syntactic positions on a formal template to the semantic positions of a verb's meaning, the template and linking rules need only be *identified*, not learned. Accordingly, children's productions are not predicted to show a pattern of initially conservative (i.e., verb-specific) usage. This notion has generated some controversy. Gertner et al. (2006), for example, found that children as young as 21 months are able to correctly identify scenes described using novel verbs in transitive sentences. The authors suggest that this is evidence that children's understanding of the transitive pattern is not tied to

a particular lexical item, adding that children's performance does not seem to be influenced by their vocabularies since they failed to find any significant correlations between performance and vocabulary size and because 21-month-olds have rather small vocabularies to begin with. Moreover, 21 months is earlier than the age at which the previously mentioned studies suggest schema-based constructions develop. Dittmar and colleagues (Dittmar et al. 2008), however, argue that the results obtained by Gertner and colleagues were due largely to methodology. In particular, they suggest that the preferential looking paradigm used a practice phase (as is common) in which children were primed with several transitive sentences using the same nouns in the same syntactic roles and with the same syntactic marking as in the test sentences. Crucially, Dittmar and colleagues were only able to replicate the results of Gertner and colleagues when they also employed the target practice/training phase. Children, however, failed to show generalization when a more neutral training phase was used to expose children to the materials and methods of the study.

On the other hand, early construction-learning doesn't appear to be an all-or-nothing situation either (although early conservativism in construction use is well-established). Evidence that young children generalize to the level of constructions to some extent comes from structural priming studies similar to the adult language production studies reviewed in section 3. Bencini and Valian (2008) examined priming in young three-year-olds (ages 2;11−3;6) in the absence of verb overlap, and controlling for animacy. During priming, the experimenter described a picture (e.g., *The milk is stirred by the spoon*) and then the child repeated the utterance. This was followed by a "Your Turn" trial, in which the child described a different picture (e.g., a picture of a hammer cracking an egg). The results showed abstract priming of passive sentences, suggesting that 3-year-olds may produce at least some verb-independent constructions.

A crucial tenet of construction grammar is that learners are motivated to abstract to the level of the construction to determine the meanings of the sentences they hear. To examine whether constructional forms are predictive of sentence meaning in the naturally occurring input that children hear, Goldberg et al. (2005) examined a corpus of child directed speech to investigate how consistently the meaning of a construction was encoded by the meaning of the verb used in the construction on the one hand, and the meaning of the construction itself on the other.

The authors looked at two constructions: caused-motion, and ditransitive and examined verbs and constructions in terms of their cue validity and category validity. Cue validity is the probability that an entity belongs to a certain category given the occurrence of a certain cue or feature. Category validity is the inverse: the probability that an entity will have a certain cue or feature given that it is a member of a certain category. In the study, the authors investigated the cue validity of verbs for sentence meaning (e.g., the probability that a sentence [the object] has the meaning of "caused-motion" [the category] given that the verb is *put* [the cue]. Likewise, they investigated the category validity of verbs in sentences (i.e., the probability that a sentence with a caused-motion meaning would contain the verb *put*). Their analyses found that while some verbs had perfect cue validity − that is, they perfectly predicted the constructions that they would appear in (e.g., *put* in the caused-motion construction) − the cue validity of most other verbs was quite low. In fact, they found the cue validity of constructions to be as least as good as the cue validity of individual verbs. In contract, the authors found that constructions have much higher category validity than do verbs. That is, given a caused-motion meaning,

for example, a sentence is much more likely to be framed in a caused-motion construction than it is to contain any particular verb (e.g., *put*). This is due to the fact that there is such a large number of different verbs that can appear in a given construction, and since only a few of the verbs − typically those called general purpose or light verbs − encode a meaning the same as the construction, the average category validity of verbs approaches zero as more verbs are considered in the analysis. This leads us to conclude that constructions are at least as useful for determining the meaning of an utterance as are verbs, but they occur with a given meaning more consistently than do verbs in general.

One might also ask whether the learner is able to use the distributional properties of the input to determine what *not* to say. That is, to determine that *She told her the news* is acceptable while *She explained her the news* sounds odd (examples from Goldberg 2011). Several researchers (e.g., Bowerman 1996; Goldberg 2006, 2011; Pinker 1989) have pointed out that the notion of entrenchment − the idea that we choose one way of expressing an idea simply because of the high frequency with which it occurs − is not an entirely sufficient explanation since it doesn't account for why some verbs, which occur with disproportionately high frequency in one argument structure construction are still acceptable when used in a different argument structure construction (i.e., one in which they rarely occur). *Sneeze*, for example, is entrenched in the intransitive construction, yet the utterance *I sneezed the ice cream cone into my lap*, in which *sneeze* occurs in the transitive and caused motion constructions, is acceptable in spite of the rarity of the use of *sneeze* with a direct object. To solve this problem, Goldberg (1993, 1995, 2006, 2011), building on Pinker's (1989) proposal for a preemptability marker in children's grammar, proposed a process of statistical preemption whereby construction A preempts construction B to the extent that a) both constructions ought to be equally appropriate in the given discourse context, and b) construction A occurs rather than construction B. Conducting an analysis of the dative and ditransitive constructions in the 450 million word Corpus of Contemporary American English, Goldberg (2011) shows that in discourse contexts in which the ditransitive might have been expected, the dative was used significantly more than would be expected by chance (83 % of the time on average, ranging from .53−1.0).

Experimental evidence also suggests that the notion of statistical preemption is correct. Brooks and Tomasello (1999), for example, modeled the description of a doll swinging a house on a rope by saying *The house is tamming* (intransitive) and *The doll is helping the house tam* (each repeated 44 times). A different group of children heard transitive and causative sentences: *The doll is tamming the house* and *The house is getting tammed*. When children were later asked to describe the scenes, children who heard the intransitive models used *tam* intransitively the vast majority of the time, while children who heard the transitive models had an overwhelming tendency to use it transitively.

Boyd and Goldberg's (2011) investigation of novel a-adjectives produced a similar experimental effect. A-adjectives like *asleep* and *alive* are dispreferred prenominally (*The asleep boy*, *The alive plant*). When adults were presented with two novel a-adjectives in relative clauses (e.g., *The fox that's adax*) just three times each, speakers treated those two novel a-adjectives in the same way as they treated known a-adjectives, producing them in relative clauses rather than in prenominal position. In fact, even when given two additional a-adjectives that they had not seem previously, participants still treated

them as they did the known a-adjectives. Unlike these novel a-adjectives, novel adjectives not beginning with *a-* were freely used prenominally. Boyd and Goldberg's results suggest not only that statistical preemption is at work, but also that statistical preemption may be generalized across categories.

Children's ability to learn argument structure constructions themselves, that is to map novel constructional forms to novel meanings without being influenced (for better or worse) by patterns of language that the child already knows was recently investigated by Goldberg and colleagues in a number of studies that have produced evidence that children are in fact able to assign a novel meaning to a novel construction (e.g., Goldberg et al. 2005; Casenhiser and Goldberg 2005; Boyd et al. 2009).

The general paradigm used in each of the studies to date is reminiscent of the preferential looking paradigm used to test children's understanding of linguistic constructions (e.g., Fisher 1996; Naigles 1990). In it, a novel construction was employed whose meaning indicated that an NP theme appeared in an NP location in the manner specified by a nonsense verb. The form was as follows:

NP_{theme} $NP_{location}$ nonsense verb

The utterances generated with this construction were then paired with video-taped scenes depicting their meaning. For example, *the spot the king moopoed* indicated that the spot (NP_{theme}) appeared on the king ($NP_{location}$) in the manner indicated by the verb (in this case, "fading into existence"). The paradigm is rounded out by using a training phase in which participants are exposed to the utterances paired with the videotaped examples of the utterance's meaning. The intent is to simulate in a controlled manner the sorts of pairings between scenes and utterances that a learner would experience when exposed to a novel construction (cf. Hauser et al. 2002). In the testing phase of the experiment, two minimally different scenes are placed side-by-side while an utterance is played. The child is instructed to touch the scene that corresponds to the utterance. In this paradigm, only the meaning of the noun phrases is known. Thus participants had to determine from context, the meaning of the verb, the meaning of the construction, and the form of the construction. In fact, they also had to determine that the word order did in fact have a meaning rather than being haphazard.

The studies have demonstrated that children can generalize beyond the input they receive to distinguish between a simple transitive scene using transitive syntax (<agent> <verb> <patient>) and a scene of appearance using the novel appearance construction (with novel verbs), and that participants are able to use such newly acquired constructions productively − even when mappings run counter to specifications which are claimed to be universal (Pinker 1989).

4.1. Construction learning as category learning

Other work has investigated construction learning as an instance of category learning that is subject to the same sorts of facilitative and inhibitory effects as other types of category learning (see also Ramscar this volume). Goldberg and colleagues (Goldberg et al. 2007) present evidence that parallels evidence derived from non-linguistic category

learning (Gentner and Medina 1998; Markman and Gentner 1993), suggesting that early presentation of stimuli with shared concrete similarity facilitates construction learning. Other work has demonstrated a facilitative effect on construction learning when exemplars follow a so-called Zipfian distribution (Zipf 1935) in which the frequency with which a verb occurs in a given construction accounts for the lion's share of tokens encountered by learners (Casenhiser and Goldberg 2005; Goldberg et al. 2004). A number of corpus-based studies (e.g., Gries et al. 2005; Gries and Wulff 2005; Cameron-Faulkner et al. 2003), have suggested that natural language input tends to mirror this effect (see also Divjak and Caldwell-Harris this volume for a discussion of frequency effects), and evidence from non-linguistic category learning (Elio and Anderson 1984) has shown a facilitative effect for such an input distribution.

This particular effect, however, is not to be overstated since the importance of type frequency (the frequency of occurrence of a pattern or category) in generalization may overshadow the effects of Zipfian distributions. In ESL studies (see also Ellis and Wulff this volume), McDonough and Kim (2009) found a facilitative effect of greater type frequency in priming *wh*-questions, and Collins and colleagues (Collins et al. 2009) also found type frequency (along with perceptual salience) to reliably distinguish early-learned L2 constructions from those that are learned later. Indeed, the facilitative effect of skewed input appears somewhat fragile and may well be limited to early learning, or may become washed out by extended training. In teaching the English ditransitive construction to Korean speakers, for example, Year and Gordon (2009) trained participants for a total of 200 minutes. Though participants did learn the construction, corroborating earlier results, the authors failed to find a facilitative effect for skewed input.

4.2. Neurolinguistic research on construction learning

Nonetheless, the notion of construction learning as an instance of category learning is an important one that suggests the learnability of syntax in the absence of innate categories. Moreover, there is now emerging neurophysiological evidence supporting the notion. Johnson and colleagues (in press) investigated the neural correlates of construction learning by presenting participants with the appearance construction used the Goldberg and colleagues' previous experiments. They compared fMRI activation during this condition with activation during a random condition in which participants encountered the same scenes, but the words were presented in random order (i.e., consistent meaning with no consistent constructional form). They found activation in neural areas related to statistical learning (specifically the left ventral striatum) during the patterned construction learning condition, but not during the condition in which participants were presented with scrambled words (i.e., when they were not learning a construction). This result presents the first evidence of the neurophysiological reality of construction learning. But more to the point of construction learning as an instance of category learning, they also found that the patterned condition showed increasing activation in areas associated with non-linguistic pattern learning (i.e., the posterior precuneus) over the course of the experiment, while no such activation was evident in the random condition. This pattern of activation suggests a neurocognitive kinship between construction learning and non-linguistic category learning.

In the only other neurolinguistic study of construction-learning, Allen and colleagues (2012) conducted an fMRI experiment designed to distinguish regions of neural activation during processing of the ditransitive (*Jessica sold Mike a hotdog*) and dative (*Jessica sold a hotdog to Mike*) constructions. Traditional projectionist theories suggest that such pairs of constructions have equivalent semantics owing to the premise that they are derived from the same underlying representation (e.g., Baker 1996; Hale et al. 1997). Others have argued that the two constructions have subtle but different meanings (e.g., Goldberg 2002) wherein the ditransitive connotes intended transfer and the dative indicates caused motion. Accordingly, if the two constructions are represented and/or processed differently by the brain, neurological differences ought to be able to be detected. This is, in fact, what Allen and colleagues found. Specifically, they found differences in processing for the two constructions with greater activation localized to the left anterior portion of Broadmann Area 22, which has been associated with the understanding and generation of words, and left Broadmann Area 47, which has been implicated in syntactic processing. This result holds in spite of the fact the lexical items in the sentences were identical (excepting the addition of *to* in the dative construction). Moreover, no such differences were found in controls in which the lexical items were presented in scrambled order.

5. Conclusion

In this chapter we have reviewed evidence for a constructional account of argument structure grounded in the empirical evidence for this approach in language use (comprehension and production) and language acquisition. We have reviewed evidence demonstrating that verb independent mappings from sentence level relational meanings to sentence forms are used by speakers to compute sentence meanings alongside verbs, that these mappings are learnable, and that they are at work in the process of language production both in adults and in children. Evidence for a constructional approach to argument structure within linguistics is now solidly convergent with evidence from disparate fields, making construction type units particularly useful to capture linguistic behaviors beyond the classic linguistic data.

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29. Default Nonliteral Interpretations
The case of negation as a low-salience marker

1. Introduction

This chapter looks into some emerging negative constructions in Hebrew.[1] It argues that such infrequent utterances convey *novel* nonliteral (e.g., metaphorical, sarcastic) interpretations by default. *Default nonliteral utterance-level interpretation* is a new notion, not yet (sufficiently) discussed in cognitive linguistics. It focuses both on "defaultness" and "nonliteralness", but importantly, also on the notion of "utterance-level *inter-*

[1] On emerging constructions in cognitive linguistics and construction grammar, see e.g., Bybee (2006); Divjak and Caldwell-Harris (this volume); Israel (2011).